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# PHARMACOGNOSY AND PHYTOCHEMISTRY - II

## UNIT 2

TOPIC :

- **Volatile oils :** Mentha, Clove, Cinnamon, Fennel, Coriander,



## Volatile Oils (Essential Oils)

- Volatile oils, also known as essential oils, are odoriferous (fragrant), volatile, and aromatic liquids obtained from various parts of plants such as leaves, flowers, fruits, bark, or roots.
- They evaporate readily on exposure to air at room temperature and possess the characteristic aroma of the plant from which they are obtained.

### General Characteristics

- Volatile in nature – evaporate when exposed to air.
- Insoluble in water but soluble in alcohol, ether, and organic solvents.
- Lighter than water, though a few are heavier (e.g., oil of clove).
- Possess a strong characteristic odor and taste.
- Do not leave a greasy stain on paper (unlike fixed oils).

### Classification

#### A. Based on Chemical Nature

1. Hydrocarbon oils – Limonene (Orange oil), Pinene (Turpentine oil)
2. Alcoholic oils – Menthol (Peppermint oil), Geraniol (Rose oil)
3. Aldehydic oils – Cinnamaldehyde (Cinnamon oil), Citral (Lemon oil)
4. Ketonc oils – Menthone (Peppermint oil), Camphor (Camphor oil)
5. Phenolic oils – Thymol (Thyme oil), Eugenol (Clove oil)
6. Ester oils – Methyl salicylate (Wintergreen oil)

#### B. Based on Plant Part Used

- Leaf oils → Eucalyptus, Mentha
- Flower oils → Rose, Jasmine
- Fruit oils → Lemon, Orange
- Bark oils → Cinnamon
- Root oils → Ginger, Vetiver

### Uses and Applications

- Medicinal uses:
  - Carminative, antiseptic, expectorant, analgesic, antispasmodic.
- Pharmaceutical uses:
  - Used as flavoring and perfuming agents in formulations.
- Cosmetic uses:
  - Used in perfumes, soaps, lotions, and creams.

## Mentha

- Common Name: Mint, Peppermint
- Biological Source: *Mentha piperita* and *Mentha arvensis*, *Mentha spicata*
- Family: Lamiaceae (Labiatae)
- Part Used: Leaves and flowering tops
- Geographical Source:
  - Widely cultivated in India, Japan, USA, UK, and Europe.
  - In India, mainly grown in Uttar Pradesh, Punjab, and Haryana.



Mentha is an aromatic, perennial herb with square stems, opposite leaves, and purple or pink flowers. The plant has a strong, pleasant, cooling odour due to volatile oils.

### Composition

| Constituent                                | Percentage / Function            |
|--------------------------------------------|----------------------------------|
| Volatile oil (Mentha oil)                  | 1–3%                             |
| → Menthol                                  | 30–55% (main active constituent) |
| → Menthone                                 | 10–30%                           |
| → Menthofuran, Cineole, Limonene           | Trace amounts                    |
| Tannins, Flavonoids, and Bitter principles | Minor constituents               |

### Chemistry & Chemical Classes

- Chemical Class: Volatile oils (Monoterpenes)
- Main Active Compound: Menthol ( $C_{10}H_{20}O$ )
- Other Compounds: Menthone, Isomenthone, Menthofuran, Cineole
- Chemical Nature:
  - Menthol: A cyclic alcohol
  - Menthone: A ketone derivative
  - Both belong to the terpenoid (isoprenoid) group

| Compound | Chemical Class | Effect                     |
|----------|----------------|----------------------------|
| Menthol  | Alcohol        | Cooling, mild anesthetic   |
| Menthone | Ketone         | Fragrant, flavouring agent |
| Cineole  | Ether          | Expectorant                |
| Limonene | Hydrocarbon    | Fragrance component        |

## Biosources

- Botanical Source: *Mentha piperita*, *Mentha arvensis*, *Mentha spicata*
- Family: Lamiaceae
- Part Used: Leaves and flowering tops
- Cultivation:
  - Grown in cool, moist climates.
  - Prefers light, well-drained soils.
  - Harvested just before flowering when the oil content is maximum.
- Extraction:
  - Steam distillation of fresh or partially dried leaves → gives Mentha oil.
  - Oil is then cooled to crystallize menthol.

## Therapeutic Uses

Mentha and its oil are used in medicine, cosmetics, and food industry.

| Therapeutic Use             | Description                                                                     |
|-----------------------------|---------------------------------------------------------------------------------|
| 1. Carminative              | Relieves gas and stomach discomfort.                                            |
| 2. Antispasmodic            | Relaxes smooth muscles of GIT.                                                  |
| 3. Antiseptic and Analgesic | Menthol gives a cooling and pain-relieving effect on skin and mucous membranes. |
| 4. Expectorant              | Helps in cough and cold preparations.                                           |
| 5. Flavoring Agent          | Used to improve the taste of medicines and toothpastes.                         |
| 6. Local Anaesthetic        | Cooling effect in topical creams and throat lozenges.                           |

## Pharmacological Actions

- Produces cooling sensation (activates cold receptors).
- Mild antiseptic and analgesic.
- Improves digestion and relieves nausea.

## Commercial Applications

- Pharmaceutical Uses:
  - Used in toothpastes, mouthwashes, cough syrups, lozenges, and balms.
  - Menthol crystals used in ointments and nasal inhalers.
- Food Industry:
  - Used as flavouring in candies, chewing gums, and beverages.

## Clove

- Common Name: Clove
- Biological Source: Dried flower buds of *Syzygium aromaticum*
- Family: Myrtaceae
- Part Used: Dried flower buds
- Geographical Source:
  - Native to Indonesia (Moluccas Islands)
  - Cultivated in India (Kerala, Tamil Nadu, Karnataka), Zanzibar, Sri Lanka, and Madagascar



→ Clove is a small, evergreen tree about 10–12 meters tall. The buds are collected just before they open, then dried until they turn dark brown. They have a strong, spicy aroma and pungent taste due to the presence of volatile oil (clove oil).

### Composition

| Constituent                     | Percentage / Role             |
|---------------------------------|-------------------------------|
| Volatile Oil (Clove oil)        | 15–20%                        |
| → Eugenol                       | 70–90% (main active compound) |
| → Eugenyl acetate               | 10–15%                        |
| → $\beta$ -Caryophyllene        | Minor                         |
| Tannins                         | 10–15% (astringent)           |
| Resins, Mucilage, and Fixed oil | Trace amounts                 |

### Chemistry & Chemical Classes

- Chemical Class: Volatile oils (Phenylpropanoids)
- Main Chemical Constituents:
  - Eugenol ( $C_{10}H_{12}O_2$ ): A phenolic compound responsible for clove's antiseptic and analgesic properties.
  - Eugenyl acetate: Ester form of eugenol.

| Compound               | Chemical Nature   | Action                                  |
|------------------------|-------------------|-----------------------------------------|
| Eugenol                | Phenolic compound | Analgesic, antiseptic, local anesthetic |
| Eugenyl acetate        | Ester             | Fragrance, flavour                      |
| $\beta$ -Caryophyllene | Sesquiterpene     | Aromatic, anti-inflammatory             |

## Biosources

- Botanical Source: Dried flower buds of *Syzygium aromaticum*
- Family: Myrtaceae
- Cultivation:
  - Grown in tropical climates with rich, loamy soil and heavy rainfall.
  - Clove trees start producing buds after 7–8 years.
- Collection:
  - Buds are collected when they change color from green to pink, but before they open.
  - Then sun-dried or smoke-dried until brown.
- Extraction:
  - Steam distillation of buds gives clove oil.

## Therapeutic Uses

Clove and clove oil have important medicinal and pharmaceutical applications.

| Therapeutic Use                   | Explanation                                                                       |
|-----------------------------------|-----------------------------------------------------------------------------------|
| 1. Analgesic and Local Anesthetic | Eugenol provides pain relief, especially in toothache.                            |
| 2. Antiseptic / Antimicrobial     | Effective against bacteria and fungi.                                             |
| 3. Carminative and Stimulant      | Used to relieve flatulence and improve digestion.                                 |
| 4. Antispasmodic                  | Relaxes smooth muscles of the gastrointestinal tract.                             |
| 5. Dental Applications            | Used in tooth powders, mouthwashes, and dental fillings (Zinc eugenolate cement). |
| 6. Antioxidant                    | Protects against oxidative stress in herbal preparations.                         |

## Pharmacological Actions

- Antiseptic
- Analgesic
- Carminative
- Anti-inflammatory

## Mechanism of Action

- Eugenol acts on sensory nerve endings to block pain sensation — giving a local anesthetic effect.
- It also denatures bacterial proteins, causing antiseptic action.
- In the GIT, it stimulates enzyme secretion and reduces gas formation.

## Commercial Applications

| Application Area        | Examples / Details                                                     |
|-------------------------|------------------------------------------------------------------------|
| Pharmaceuticals         | Used in dental creams, toothache drops, mouthwashes, antiseptic creams |
| Dental Uses             | Eugenol forms Zinc eugenolate cement for temporary fillings            |
| Flavoring Agent         | Used in toothpaste, syrups, and mouth fresheners                       |
| Food Industry           | Spice and flavouring in bakery, sauces, and beverages                  |
| Perfumery and Cosmetics | Used in soaps, perfumes, and cosmetics due to its pleasant aroma       |
| Insect Repellent        | Clove oil repels mosquitoes and insects                                |

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## Cinnamon

- Common Name: Cinnamon
  - Biological Source: Dried inner bark of *Cinnamomum zeylanicum* (also called *Cinnamomum verum*)
  - Family: Lauraceae
  - Part Used: Dried inner bark
  - Geographical Source:
    - Native to Sri Lanka (Ceylon) and South India
    - Also cultivated in China, Indonesia, Vietnam, and Madagascar
- Cinnamon is the dried inner bark of a small evergreen tree. The bark is thin, smooth, and has a pleasant, sweet aroma and warm, spicy taste. It is rolled into quills (sticks) when dried.



### Composition

| Constituent                 | Percentage / Function           |
|-----------------------------|---------------------------------|
| Volatile Oil (Cinnamon oil) | 0.5 – 2.0%                      |
| → Cinnamaldehyde            | 60 – 75% (main active compound) |
| → Eugenol                   | 5 – 10%                         |
| Tannins                     | 8 – 10% (astringent)            |
| Mucilage & Sugars           | Minor constituents              |
| Calcium Oxalate Crystals    | Structural component            |

### Chemistry & Chemical Classes

- Chemical Class: Volatile oil (Aromatic aldehyde)
- Major Constituents:
  - Cinnamaldehyde ( $C_9H_8O$ ): Gives cinnamon its odor and taste; acts as an antimicrobial and carminative.
  - Eugenol ( $C_{10}H_{12}O_2$ ): Phenolic compound with antiseptic and flavouring properties.

| Compound       | Chemical Nature   | Pharmacological Action             |
|----------------|-------------------|------------------------------------|
| Cinnamaldehyde | Aromatic aldehyde | Carminative, stimulant, antiseptic |
| Eugenol        | Phenol            | Analgesic, flavouring agent        |

## Biosources

- Botanical Source: *Cinnamomum zeylanicum* (True Cinnamon)
- Family: Lauraceae
- Part Used: Inner bark
- Cultivation:
  - Prefers tropical climate with rich, well-drained soil.
  - Grown in Sri Lanka, South India (Kerala, Tamil Nadu), and Indonesia.
- Collection:
  - Bark is peeled from young shoots after removing the outer corky layer.
  - The inner bark rolls naturally into quills upon drying.
- Extraction:
  - Steam distillation of bark and leaves → Cinnamon oil (essential oil).

## Therapeutic Uses

Cinnamon has been used since ancient times as a spice, flavoring, and medicine.

| Therapeutic Use               | Explanation                                                  |
|-------------------------------|--------------------------------------------------------------|
| 1. Carminative & Stomachic    | Relieves flatulence, nausea, and improves digestion.         |
| 2. Antiseptic & Antimicrobial | Used in mouthwashes, tooth powders, and topical antiseptics. |
| 3. Astringent                 | Useful in mild diarrhea and sore throat.                     |
| 4. Flavoring Agent            | Added to syrups, teas, and oral medicines.                   |
| 5. Antioxidant                | Helps in reducing oxidative stress.                          |
| 6. Hypoglycemic               | Shown to lower blood sugar levels (in small doses).          |

## Pharmacological Actions:

- Carminative (relieves gas)
- Stimulant
- Antiseptic
- Antioxidant
- Antidiabetic (mild)

## Mechanism of Action

- Cinnamaldehyde stimulates the secretion of digestive enzymes → improves digestion.
- It also destroys microorganisms by disrupting bacterial cell walls.
- Has anti-inflammatory and antioxidant effects by inhibiting free radicals.

## Commercial Applications

| Application           | Examples / Uses                                                  |
|-----------------------|------------------------------------------------------------------|
| Pharmaceuticals       | Used in mouthwashes, cough syrups, and carminative mixtures      |
| Food Industry         | Flavoring agent in spices, bakery, confectionery, and beverages  |
| Perfumery & Cosmetics | Used for its sweet aroma in soaps and perfumes                   |
| Dental Products       | Included in toothpaste, powders, and mouth fresheners            |
| Traditional Medicine  | Used in Ayurveda and Unani for cold, cough, and digestive issues |

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## Fennel



- Common Name: Fennel
- Botanical Name: *Foeniculum vulgare* Mill.
- Family: Apiaceae (Umbelliferae)
- Part Used: Dried ripe fruits (sometimes called seeds) and volatile oil
- Description:
  - Fennel is a biennial or perennial aromatic herb.
  - It grows up to 2 meters tall and has feathery leaves and yellow flowers arranged in umbels.
  - The fruits are small, oblong, and greenish-brown with a pleasant aromatic odor and sweet taste.
- Significance: Used as a flavoring agent, carminative, and digestive in traditional medicine and food.

### Composition

- Major Active Constituents:
  - Volatile oil (1–4%) — the main component responsible for aroma and medicinal properties.
- Main Constituents of Volatile Oil:
  - Anethole – gives characteristic sweet aroma and flavor.
  - Fenchone – contributes to the bitter taste and aroma.
  - Estragole (methyl chavicol) – minor component, aromatic.
- Other Constituents:
  - Fixed oils, proteins, sugars, vitamins, and minerals.

### Chemistry & Chemical Classes

- Chemical Class: Volatile (essential) oils – mainly phenylpropanoids and monoterpenes.
- Important Chemical Compounds:
  - Anethole ( $C_{10}H_{12}O$ ) – aromatic compound, used in perfumery and medicine.
  - Fenchone ( $C_{10}H_{16}O$ ) – bicyclic monoterpene ketone.
  - Estragole ( $C_{10}H_{12}O$ ) – similar to anethole but slightly more pungent.
- Properties:

- Volatile oils are colorless to pale yellow liquids with a sweet, aromatic smell.
- Soluble in alcohol and organic solvents.

## Biosources

- Biological Source: Dried ripe fruits of *Foeniculum vulgare*.
- Cultivation:
  - Widely cultivated in India, Egypt, China, and Mediterranean countries.
  - Prefers sunny climate and well-drained soil.
- Collection: Fruits are collected when ripe, dried, and sometimes distilled for oil extraction.

## Therapeutic Uses

- Digestive Aid: Stimulates appetite, relieves bloating and gas (carminative).
- Antispasmodic: Relaxes smooth muscles of intestines and uterus.
- Expectorant: Helps in cough and cold by loosening mucus.
- Galactagogue: Enhances milk secretion in nursing mothers.
- Antimicrobial: Mild antibacterial and antifungal effects.
- Aromatic and Flavoring Agent: Improves taste and odor of medicines.

## Commercial Applications

- Pharmaceutical Use:
  - Used in carminative mixtures, gripe water, and digestive tonics.
  - Fennel oil used in cough syrups and lozenges.
- Food Industry:
  - Used as a flavoring agent in bakery items, confectionery, liqueurs, and pickles.
  - Commonly chewed after meals as a mouth freshener.
- Cosmetic Use:
  - Used in perfumes and soaps due to its sweet fragrance.
- Other Uses:
  - Fennel essential oil used in aromatherapy.

## Coriander



- Common Name: Coriander, Dhania
- Botanical Name: *Coriandrum sativum* L.
- Family: Apiaceae (Umbelliferae)
- Part Used: Dried ripe fruits (commonly called seeds) and volatile oil
- Description:
  - Coriander is an annual aromatic herb growing up to 1 meter in height.
  - It has delicate, divided leaves and small white flowers in compound umbels.
  - The fruits are small, round, yellowish-brown, and aromatic.
- Significance:
  - Used as a culinary spice, flavoring agent, and traditional medicine for digestive problems.

### Composition

- Major Active Constituents:
  - Volatile oil (0.1–1%) – main active component.
- Main Constituents of Volatile Oil:
  - Linalool ( $C_{10}H_{18}O$ ) – gives the pleasant aroma and flavor.
  - Geraniol – contributes to fragrance.
  - Camphor and borneol – minor constituents.
- Other Constituents:
  - Fixed oil (up to 20%), proteins, carbohydrates, and minerals.

### Chemistry & Chemical Classes

- Chemical Class: Volatile (essential) oils – mainly monoterpenes and alcohols.
- Important Chemical Compounds:
  - Linalool ( $C_{10}H_{18}O$ ) – main constituent, aromatic alcohol.
  - Geraniol,  $\alpha$ -pinene, limonene, camphor – minor monoterpenes.
- Properties:
  - The volatile oil is colorless to pale yellow with a sweet, spicy odor.
  - Soluble in alcohol and organic solvents; sparingly soluble in water.

## Biosources

- Biological Source: Dried ripe fruits of *Coriandrum sativum* L.
- Cultivation:
  - Grown widely in India, Russia, Morocco, and Mediterranean regions.
  - Requires cool climate and well-drained loamy soil.
- Collection:
  - Fruits are harvested when fully ripe, dried, and sometimes distilled to obtain coriander oil.

## Therapeutic Uses

- Carminative: Relieves gas, bloating, and indigestion.
- Stomachic: Improves appetite and digestion.
- Antispasmodic: Reduces intestinal spasms.
- Antimicrobial: Mild antibacterial and antifungal activity.
- Anti-inflammatory and Antioxidant: Due to linalool content.
- Flavoring Agent: Used to mask unpleasant taste in medicines.

## Commercial Applications

- Pharmaceutical Uses:
  - Used in digestive tonics, carminative mixtures, gripe water, and cough syrups.
  - Volatile oil used in aromatic preparations and liniments.
- Food Industry:
  - Common spice in curries, pickles, and sauces.
  - Coriander oil and seed powder used as flavoring agents.
- Cosmetic Uses:
  - Oil used in perfumes, soaps, and lotions due to its pleasant fragrance.
- Other Uses:
  - Seeds used as condiment and mouth freshener.